from a suitable datum temperature or pressure, the lines might be interchanged, a step of one degree of temperature (Fig. 4) corresponding to a step of one millimetre of pressure in the same direction for the upper layer (Fig. 2), and in the opposite direction for the lower layer (Fig. 3).

The complexity of the surface pressure arises, therefore, not from the upper layer alone, nor from the lower layer alone, but from the superposition of the two. We can resolve the surface pressure into two components, one due to the upper stratum above 4000 metres which, if it acted alone, would produce a general circulation from west to east around minima of pressure near the poles; the other, due to the lower stratum, which, if it acted alone, would produce a circulation from east to west. Both circulations would correspond closely with the surface distribution of isotherms. Where the one is predominant, in the lower middle latitudes, we get resultant westerly circulation; where the other is predominant, near the poles of cold, we get an easterly circulation. Between the two we get a region of minimum pressure and a merging of the two circulations which gives rise to the circular storms of the northern and southern temperate zones.

It appears, therefore, that we ought to regard the surface distribution of temperature as giving rise to a distribution of pressure in the lower stratum tending to maintain a circulation of air from east to west round the poles of cold. Extending this idea, a region of cold in the northern hemisphere should tend to maintain a clockwise circulation round its centre in the lower atmosphere, and a region of heat a counterclockwise circulation.

The reciprocity between the pressure distribution of the upper and lower layers is of course not fortuitous. Hann has shown that the expansion of the lower layer by heat increases the pressure at a given level in the upper regions, without altering the pressure at the surface, by the mere thrusting of part of the air upwards; so that the observed effect of expansion over a large area is to diminish the pressure of the lower stratum and increase, by an equal amount, that of the upper. Referring to the diagrams again, the effect of increased surface temperature upon the isobars of Fig. 3 would be a bulge of the isobars towards the region of low pressure—the equatorial regions; upon the upper isobars there would be a corresponding bulge towards the region of higher pressure, again the equatorial regions. Thus the lines of both diagrams would be affected geographically in an exactly similar way and to the same extent; they would thus preserve their similarity in spite of temperature variations at the surface.

It would be interesting to consider what the effect of the daily solarisation of the earth should be from this point of view. Primarily it should produce no pressure variation at the surface; but inequalities of motion in the upper and lower air would probably alter the relative phase or magnitude of the disturbance of the two components, and hence give rise to daily variations of pressure at the surface, and thus necessarily produce a diurnal variation of the barometer.

Other consequences follow from the treatment of the distribution of pressure due to the weight of the lower layer as producing, or rather maintaining, a circulation in the one direction or the other about the colder or warmer regions, as the case may be, instead of flow from cold regions to hot.

One important result as regards the formation of circular storms in our latitudes may be inferred from this method of analysing the distribution of surface pressure. Friends have frequently suggested to me that our circular storms are like the eddies formed when water flows through a bridge; and to them I have always put the question, What in the atmosphere stands for the bridge? I am now prepared to recognise that the caps of relatively cold air in the north and south polar regions form an adequate representation of the piers of the bridge. In the lower air, where the pressures of the polar caps are dominant, they stop the westerly currents which still flow in lower latitudes, and replace them by currents from the east. Between these two currents is a field where mixing must take place, and circular eddies may be formed.

What happens in the equatorial regions is another story. Buys Ballot's law shows that the equator is subject to a peculiar meteorological condition. If you stand with your back to the wind north of the equator, the low barometer is on your left; south of the equator, it is on your right. There must be a transition region where the law ceases to apply, as, indeed, one would expect if Buys Ballot's law is the practical expression of motion with an acceleration due to the rotation of the earth, and varying as the sine of the latitude.

In the upper air of the equatorial regions there is probably a persistent flow from the east, as shown by observations of clouds and of the Krakatoa dust. In respect of the formation of eddies, this current will act like an intermediate pier of a bridge. Hence, in January, the river in which, upon this analogy, atmospheric eddies may be expected is a stream of air flowing round the earth in middle latitudes, divided by the equatorial belt with its region of doldrums below and easterly current above, and bounded north and south by easterly currents which correspond with the circulation of the lower atmosphere induced by the predominant influence of the polar caps of cold air. Eddies may be looked for between the easterly and westerly currents, and they are sometimes found there.

W. N. SHAW.

NOTES.

THE trustees of the Carnegie Institution met on May 18 and transacted the necessary business to provide for the transfer of all matters to the Carnegie Institution of Washington, a charter for which passed Congress and was approved on April 28. The trustees named in the Act met at once and reorganised under the new charter. The by-laws of the Carnegie Institution were adopted as the by-laws of the new organisation, and the officers of the old organisation were elected. General resolutions adopting all the obligations, &c., of the old institution were passed. Under the new charter no questions can be raised as to the competency of the institution to carry on the operations outlined in the deed of gift of the founder. The executive committee of the Carnegie Institution of Washington met after the reorganisation, and practically completed the making of grants for the year 1904. It will greatly facilitate the work of the executive committee if all those thinking of making applications for grants for 1905 will do so not later than September, as applications for grants for 1905 will then be taken up.

A SLIGHT but decided earthquake, which lasted about a second, was experienced at Derby at 3.22 p.m. on July 3. The vibration was not nearly so pronounced as on the occasion of the seismic disturbance a year ago. A similar shock was felt in the mid-Cheshire district about the same time. In Leftwich, near Northwich, the tremors were very distinct. The shock, which was also felt in Northwich, lasted two seconds, and at Sandbach four seconds. Two shocks were felt in Sheffield and the surrounding district. The tremor was from west to east. At Matlock Bath there were shocks running from north-east to south-west. The tremor appears to have been felt almost simultaneously throughout Derbyshire, south Yorkshire, Cheshire, and Staffordshire. Writing from Leek, Staffs, Mr. G. H. Martyn says the disturbance occurred there at 3h. 22½m. ± 1m. p.m. "It seemed to be a succession of about a dozen shocks in three seconds. The shocks increased to a maximum at about the third, and then diminished until imperceptible." Dr. Davison found a very slight record of the disturbance upon his seismometer at Birmingham.

The death is announced of Prof. T. Bredichin, formerly director of the Pulkowa Observatory.

The Vienna Academy of Sciences has awarded its Baumgarten prize, of the value of about 160*l.*, to Prof. Walter Kaufmann, for his investigations on the theory of electrons.

The first meeting of the trustees of the Percy Sladen fund for the assistance of scientific research (see p. 182) was held at the Linnean Society last week. The trustees will not meet for the consideration of the first applications before November next, and such applications should be addressed to the clerk to the trustees of the Percy Sladen Memorial Fund, care of the Linnean Society, Burlington House, London, W., by the 1st of that month.

The Congress of the Royal Institute of Public Health will be held at Folkestone on July 21–26, the Earl of Radnor presiding. In the preventive medicine section, Dr. Nash, medical officer of health, Southend, will open a discussion on a clean milk supply. In the section of bacteriology, Dr. Klein, the president, will give an address on the aim and scope of bacteriological analyses of water and shell-fish with reference to sewage pollution, and the report of a committee appointed to inquire into the methods of bacteriological analysis of water will be presented by Prof. Hewlett. Valuable papers and discussions are promised in the other sections—engineering, child study, and tropical medicine.

At the second annual general meeting of the fellows of the British Academy, held on June 29, Lord Reay was re-elected president, and the following corresponding fellows were elected, this being the first occasion on which such fellows have been elected:—Count Ugo Balzani, Prof. H. Diels, M. le Comte de Franqueville, Prof. M. J. de Goeje, Prof. I. Goldziher, Prof. T. Gomperz, Prof. J. L. Heiberg, Prof. K. Krumbacher, Prof. F. Leo, M. Paul Meyer, M. Georges Perrot, M. Georges Picot, and Prof. C. H. Salemann. Sir Richard Jebb read a paper on Bacchylides, dealing chiefly with three topics—the illustrations of his mythology supplied by ancient art, the traces of earlier or contemporary literature in his poems, and his relation to Pindar.

A banquet was given to Mr. Chamberlain on June 30 by the Royal Institute of Public Health, in recognition of his services to preventive and tropical medicine. In acknowledging the honour, Mr. Chamberlain referred to the progress made in recent years in medicine and surgery. He remarked in the course of his speech that the light which had been thrown on the origin of disease justified the belief that "we are on the eve of great discoveries which will relieve the human race from some of the greatest scourges which have affected it. Now, at any rate, the importance of securing healthy conditions of life is recognised by everybody who cares for the welfare of his fellow-creatures. Preventable disease, at this moment, is, as we all know, a great agent for filling our workhouses, for raising our taxes, for weakening the fibre of the people, for preventing us from competing successfully in that eternal struggle for existence which must go on as long as the world shall last. In peace it is of the utmost importance, in war the same cause destroys more of our soldiers than the bullets or the swords of the enemy, and meanwhile the administration of the Army is lessened in efficiency by the preventable disease to which the agents of the Empire are constantly subject. It is to the efforts of men like Sir Patrick Manson, Major Ross, Prof. Haffkine, and others who have been devoting their time and atention to tropical medicine, to research into the causes of tropical disease, with the remedies for those diseases—it is to that branch of the science that my attention is chiefly directed."

During a recent expedition under the auspices of the Geographical Society of Baltimore for the purpose of making scientific researches in the Bahamas, Mr. O. L. Fassig made some interesting experiments with kites at Nassau, one of which was made from a steamer hired for the purpose. The ascents were made in the early part of July, 1903, and the results are published, with diagrams, in the *Monthly Weather Review* for December last. From an average of four ascents and seventy observations, there was a decrease of 1° F. for each 100 feet of elevation up to an altitude of 500 feet; from 500 feet to 1000 feet the decrease was 1° in 143 feet; from 1000 feet to 1500 feet 1° in 167 feet; between 1500 feet and 4000 feet the average decrease was 1° for each 191 feet of elevation. As regards relative humidity, there was a steady increase from the surface (73 per cent.) up to 4000 feet (96 per cent.), with the exception of a small drop near the 3000-feet level; this drop was probably due to an excessive value caused by the kite passing through clouds just below the 2500-feet level on several occasions.

We have received from Mr. H. Arctowski, a member of the Belgian Antarctic Expedition, a summary of the meteorological results made on board the *Belgica* during its detention in the pack-ice. The paper in question is an excerpt from the *Annuaire météorologique* of the Brussels Observatory for 1904; the volume containing the hourly meteorological observations is now in the press; five memoirs dealing with other special matters have already been published. The *Belgica* entered the "pack" on February 28, 1898, and left it on March 14, 1899; during this period the ship was drifting over an area about the size of the Kara Sea. The author has discussed the daily and monthly means of the observations during a year, as if they were made at one fixed point; the results, therefore, can only be taken as approximately correct. The mean temperature of the year was 14°·7 F., maximum 36°·5 on December 27, minimum −45°·6 on September 8. The diurnal variation was notably different in the several months; grouping the three summer months together (December to February), the amplitude of the variation was 3°·8, while in winter (June to August) it was only 1°·1; in November it amounted to 8°·5. The amount of precipitation is not given; snow fell on 260 days and rain on 20 days. Between March and September auroræ were observed on 61 occasions; the phenomenon was last seen during the night of March 12–13, 1899. Fog or mist was observed on 261 days.

We have received two important papers dealing with extensions of the theory of Bessel's functions. One is by Prof. C. Cailler, in the *Mémoires* of the Geneva Physical and Natural History Society (xxxiv., 4), and contains an application of the operation designated by M. Schlesinger as Laplace's transformation; the other is a contribution by the Rev. F. H. Jackson, of H.M.S. *Irresistible*, to the Edinburgh *Transactions* (xli., 1), and deals with generalisations of certain expansions in terms of Bessel functions.

IN the *Atti* (xxxvi., 2) of the College of Engineers of Milan, Dr. G. Finzi and Dr. Nicola Soldati describe some interesting experiments on the resistance of bodies moving through air, which should have an important application to the problem of aërial navigation. The chief point of interest consists in the application of the so-called "manometric" method as opposed to the ordinary "dynamometric" method, whereby the present writers have determined the pressure at different points of planes, aërocurves, cylinders and spheres, instead of merely measuring the intensity of the resultant thrusts. For determinations of the variations in the position of the line of action and centre of pressure, such calculations should be of great value, and it is largely in these determinations that the solution of every problem in aërial navigation must lie. A gold medal has been awarded to the authors.

THE March number of the *Mémoires* of the Physical and Natural History Society of Geneva contains a general report of the work of the society for 1903 drawn up by the president, M. Paul van Berchem. The society has completed a new agreement with the municipal authorities, superseding the old agreement of 1855, which will afford the members additional facilities for the use of the town library, in which the publications of the society are deposited. Obituary notices are given of M. Alphonse Pictet, the traveller; of M. Théodor von Heldreich, the botanist; and of M. Théodore de Saussure. Profs. René Blondlot (Nancy) and Walther Spring (Liège) have been elected honorary members, and the *Mémoires* include an important paper by Marc Micheli on the Leguminosæ collected in the Mexican States by Eugène Langlassé.

WE have to acknowledge the receipt of three fasciculi (Nos. 1376–8) of the *Proceedings* of the U.S. National Museum. In the first of these Mr. H. G. Dyar catalogues the Lepidoptera of the Kootenai district of British Columbia, while in the second Messrs. Jordan and Snyder publish notes on fishes collected in Oahu and Laysan Islands, of the Hawaii group, with descriptions of new species.

IN the *Atlantic Monthly* for June, Mr. T. C. Smith records the results of his efforts to reproduce in musical notation the song of the various local phases of the American bird commonly known as the wood-thrush. The score will not enable the musician to reproduce the actual timbre of the song, all that it attempts being to symbolise roughly the tones of the musical scale to which the notes of the bird approximate.

THE Hon. Walter Rothschild has presented to the British (Natural History) Museum a female of the basking shark (*Cetorhinus*, or *Selache, maximus*) from Bergen, which has been set up by Messrs. Brazenor Brothers, of Brighton, and measures 26½ feet in length. The new specimen has replaced the male which has for some years been exhibited in the fish gallery, and is now somewhat the worse for wear. The male measures 28 feet, and is mounted with the mouth open, while Mr. Rothschild's specimen is shown with the jaws closed.

THE *Field-Naturalists' Quarterly* for June is a good number, containing interesting articles on British social wasps, protective coloration in plumage, and on the means of recognising our commoner birds. Mr. Aflalo also contributes a paper on south coast museums, which, if a little wide of the scope of the journal, conveys some useful information on their contents. The editor takes occasion to urge that in future the British Association should assign either a day in each of the sections devoted to subjects in which the field-naturalist is interested, or a special section to field natural history.

BIRMINGHAM University has issued an exhaustive report, by Mr. W. E. Collinge, on the "big-bud" disease which of late years has played such havoc among black-currant bushes in this country. The disease is produced by the black-currant gall-mite (*Eriophyes ribis*), the larvæ of which display unrivalled powers of spreading themselves over plantations. Although some success has attended the use of soap and sulphur spray, the author is of opinion that growers must rely largely on the aid of natural enemies of the pest, or on root and branch extermination of the affected bushes.

THE *Zoologist* for June contains an interesting paper by Mr. J. H. Gurney on birds and bird-migration in Norfolk and the east coast generally in 1903. As regards migration, it is pointed out that the prevalence of east winds is an important factor in producing an influx of visitors to this country, and also that while birds may leave Norway with a favourable wind *en route* for England, they are often driven from their course by encountering contrary breezes as they cross the North Sea. A notable incursion of waxwings during the year affords occasion for the remark that these birds do not visit England on account of excessive cold, but come under the category of late occasional migrants. Other rarities include a young sea-eagle, a flock of Nyroca ducks, half a dozen spoonbills, an avocet, and a blue water-hen. Spoonbills have made their appearance on the east coast continuously since 1897, and hopes are now entertained that they may once more breed in this country. To the same journal Mr. G. Renshaw contributes notes on the Amsterdam Zoological Gardens, in the course of which he repeats his mis-statement that the mounted quagga in the museum came from Knowsley.

IN the report for 1903, the trustees of the South African Museum take occasion to direct attention to the apathy displayed by the wealthy residents of South Africa to the institution under their charge, thereby presenting a regrettable contrast to their fellow millionaires in the United States. During the last twenty years all that the museum has received in the way of bequest and donation is the paltry sum of 295*l*., of which 100*l*. was given by an Indian gentleman. So far as its limited means permit, the museum appears to be making steady progress.—During the past year, according to the report, the attention of the staff of the Horniman Museum was largely directed to the development of the aquaria and vivaria which form such an attractive feature of that institution. A large number of British marine, land, and fresh-water animals have been from time to time on show during the year in the tanks and cases. Dr. Haddon's series of lectures appears to have been fairly well attended.—In the report of the Marlborough College Natural History Society, the secretary has to deplore the disastrous effect of the wet summer of 1903 on collecting and field-work generally, which has made itself felt in a decline of membership. The one compensation was the abundance of land molluscs, which was taken advantage of to compile a list of the local fauna. In other respects the society continues to flourish.

IN NATURE of February 11 (p. 349) we gave some particulars of the great rock-slide which occurred last year at Frank, in Alberta Territory, Canada. A full and interesting report on the subject, by Messrs. R. G. McConnell and R. W. Brock, has since been issued by the Geological Survey of Canada (part viii., Ann. Rep. for 1903). The conclusions arrived at fully confirm the explanations previously given by Mr. Brewer, but the authors add that recent earthquake tremors no doubt hastened the time of the final disruption. They regard the present state of Turtle Mountain as dangerous, and recommend the removal of the town of Frank to a site higher up the valley of the Old Man River. The report is illustrated by map, sections, and numerous pictorial views.

THE Geological Survey of India has revived the publication of its *Records*, a serial which was established in 1868, and amalgamated with the *Memoirs* in 1897. In justification of this step, the director, Mr. T. H. Holland, points out that during the course of the survey work many observations are made from time to time that it would be advisable to publish as promptly as possible, on account of their bearing on current scientific problems or of their economic value. The present number (vol. xxxi., part i.) contains accounts of coal-deposits, copper ore, sapphirine-bearing rock, together with miscellaneous notes on tin-ore, gem sands, &c., and selections from assays made in the laboratory relating to coal and manganese-ores. Mr. Holland expresses the hope that contributions will be made by private workers, to whom the *Records* will be open for original observations on geological subjects.

IN the April *Bulletin* of the Johns Hopkins Hospital (xv., No. 157), Dr. George Dock discusses vaccine lymph and vaccination especially as regards American practice. Dr. Watts Lee publishes studies of the sinus frontalis of man and of certain mammals, carried out both by dissections and by means of lead casts, and Dr. Hastings describes a new blood stain possessing advantages over the Romanowsky and Leishmann stains, which should prove very useful, as it is permanent in the preparations, and the solution keeps well.

IN NATURE of March 17 (vol. lxix. p. 467) a review was given of the anti-malarial operations at Mian-Mir. A second report on the subject has now been published, and gives additional details (*Sc. Mem. of the Gov. of India*, No. 9, by Lieut. S. R. Christophers, I.M.S.). The conclusions are in accordance with those expressed by Captain James, I.M.S., in the first report. It is found that the destruction of the anopheles mosquito within an area by attacking their breeding places is extremely difficult, the mere obliteration of local breeding places being useless. Thus at Mian-Mir, although large numbers of pools were filled up and drained, and almost complete absence of breeding was ensured to a distance of half a mile, adult anopheles still appeared in large and increasing numbers, apparently due to immigration from without. Although a distinct effect was produced on the incidence of malaria among the troops and on the endemic index of the native bazaars, it was only evident at the beginning of the fever season, and could not be maintained. The value of quinine administration was found to depend on the efficiency of the supervision exercised; when quinine was regularly taken the admission rate for fever was much reduced. The conclusion is formed that although some effect on malaria was produced by anti-mosquito measures, these are not those best adapted at Mian-Mir to the eventual reduction of malaria.

THE third issue of *The Central*—the journal of the Central Technical College Old Students' Association—is an excellent number. Prof. Armstrong, F.R.S., contributes the first of a series of short articles on the mechanism of combustion. Among other articles we notice two which are illustrated—one on popular motor cars, by Mr. M. O'Gorman, and the other by Mr. R. W. Sindall, on the manufacture of wood-pulp.

A SECOND edition, revised and enlarged, of the "Student's Handbook of British Mosses," by Mr. H. N. Dixon, the first edition of which was reviewed at length in our issue of September 10, 1896 (vol. liv. p. 434), with illustrations and keys to the genera and species by Mr. H. G. Jameson, has been published by Mr. V. T. Sumfield, Station Street, Eastbourne. Since the publication of the first edition of the book, some thirty species or subspecies of British mosses have been detected, together with a corresponding number of varieties. These additions have been interpolated in the second edition, and notes also have been provided where recent knowledge necessitated their inclusion. Some slight alterations, too, have been made in the general arrangement of the book.

OUR ASTRONOMICAL COLUMN.

THE NUMBER OF THE STARS.—In No. 114 of *Popular Astronomy*, Mr. Gavin J. Burns makes some calculations and deductions as to the number of stars in the entire sky from the various star catalogues and photometric durchmusterungs which have been published. On the assumption that, on the whole, the stars are evenly distributed, he deduces from the plates taken for the Greenwich zone of the Astrographic Chart that there are 38 stars brighter than the second magnitude, 13,421 brighter than the seventh, and 8,325,000 brighter than the fifteenth. The ratio of the total number of stars brighter than any one magnitude to the number brighter than the next magnitude fainter is fairly constant at about 3·4 until the tenth magnitude is reached, but beyond that there is a sudden drop to 1·9, which ratio continues down to magnitude 15. From this discussion there is strong presumptive evidence that the stars thin out as their distance from our system increases.

RADIAL VELOCITIES OF THE PLEIADES.—From an investigation of a series of plates taken with the Bruce spectrograph, using only *one* prism, Mr. W. S. Adams, of the Yerkes Observatory, has determined the radial velocities of the Pleiades stars as follows:—

Name.	Bessel's number.	Mag.	Mean vel. in km.
Electra ...	17 Tauri ...	3·8 ...	+15
Taygeta ...	19 ,, ...	4·4 ...	+ 3
Merope ...	23 ,, ...	4·2 ...	+ 6
Alcyone ...	25 ,, ..	3·0 ...	+15
Atlas ...	27 ,, ...	3·8 ...	+13

Measurements of seven spectrograms of Maia (20 Tauri) indicate that this star has a variable velocity ranging from −7·4 km. (October 30, 1903) to +20·9 km. (December 25, 1903). The lines in the spectrum are well defined, so that although the range of variability is not very large, it is almost certainly real.

The spectra of Maia and Taygeta are at variance with what we should expect to find for stars associated with a nebula, and they engender a suspicion that these stars may not be physically connected with the surrounding nebula (*Astrophysical Journal*, No. 5, vol. xix.).

AN EXPEDITION FOR SOLAR RESEARCH.—With the aid of a grant of 10,000 dollars from the Carnegie Institution, the Yerkes Observatory has sent an expedition to Mount Wilson (altitude 5886 feet), near Pasadena, California, for the purpose of making special investigations of the sun.

The Snow horizontal telescope is to be the principal instrument erected. One of the concave mirrors of the coelostat reflector, having a focal length of 145 feet, will give a solar image 16 inches in diameter, and will be used for special spectroscopic studies of sun-spots and other solar phenomena. A spectroheliograph of 7 inches aperture and 30 feet focal length is also to be used in connection with this mirror. A stellar spectrograph provided